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L14: Entry 3 of 4

File: USPT

Dec 20, 1994

DOCUMENT-IDENTIFIER: US 5374356 A

TITLE: Fluid treatment process using dynamic microfiltration and ultrafiltration

Detailed Description Text (23):

The filtrate from the dynamic microfiltration assembly 22 is passed by way of fluid pathway 24 to the ultrafiltration assembly 25. The ultrafiltration assembly 25 removes undesirable molecules and agglomerates, for example, those with molecular weights in the range of about 500-30,000 Daltons. The ultrafiltration process generally comprises a cross-flow filtration process inside a hollow fiber membrane. Many hollow fibers are typically bundled together into one housing, providing generally about 100 times more filter surface area per unit volume than traditional filtration systems. Most ultrafiltration membranes are porous, asymmetric, polymeric structures produced by phase inversion, i.e., the gelation or precipitation of a polymer from a soluble phase. Commonly used polymers include cellulose acetate, polyamides, polysulfones, poly(vinyl chloride-co-acrylonitrile)s, and poly(vinylidene fluoride). While any suitable filter media may be used in the ultrafiltration assembly, the ultrafiltration assembly will typically have a molecular weight cut-off of about 500 Daltons to about 30,000 Daltons, more typically about 500 Daltons to about 10,000 Daltons. The ultrafiltration assembly preferably has a molecular weight cut-off of about 3000 Daltons or less, more preferably about 1000 Daltons or less, and most preferably about 500 Daltons to about 1000 Daltons.

Detailed Description Text (49):

A fifty-five gallon drum of graywater was drawn from the David Taylor Research Center and filtered through a series of filters characterized by decreasing pore size. The first filter was a knit mesh screen which simulated a duplex strainer. The second and third filters simulated the filtration of the dynamic microfiltration assembly. The second filter was an Ultipor.RTM.GF 3 .mu.m absolute filter (Pall Corporation), while the third filter was a Sanitary Filter with a nylon membrane and a 0.04 .mu.m absolute rating (Pall Corporation). The fourth filter was an Ultrafilter.RTM. model VIP-3017 (Asahi), with a cut-off molecular weight of 6000 Daltons, and simulated the ultrafiltration assembly.

Other Reference Publication (2):

Brandon et al., "Complete Reuse of Textile Dyeing Wastes Processed with Dynamic Membrane Hyperfiltration," J. Am. Assoc. Textile Chemists & Colorists, 5(7), 134-37 (Jul. 1973).

Other Reference Publication (5):

Chiang et al., "Ultrafiltration and Reverse Osmosis of the Waste Water from Sweet Potato Starch Process," J. Food Science, 51(4), 971-974 (1986). X

Other Reference Publication (6):

Eriksson, "Nanofiltration Extends the Range of Membrane Filtration," Environmental Progress, 7(1), 58-62 (Feb. 1988).

Other Reference Publication (7):

Grieves et al., "Membrane Ultrafiltration to Treat Laundry Wastes and Shower Wastes for Water Reuse," Society of Automotive Engineers Intersociety Conference on Environmental Systems (Seattle, Jul. 29-Aug. 1, 1974).

Other Reference Publication (11):

Rautenbach et al., "Separation Potential of Nanofiltration Membranes," Desalination, 77, 73-84 (1990).

Other Reference Publication (13):

Sammon et al., "The Application of Membrane Processes in the Treatment of Sewage,"
Process Biochemistry, 4-12 (Mar. 1975).

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Search Results - Record(s) 1 through 4 of 4 returned.

☐ 1. Document ID: US 6036854 A

L14: Entry 1 of 4

File: USPT

Mar 14, 2000

US-PAT-NO: 6036854

DOCUMENT-IDENTIFIER: US 6036854 A

TITLE: System for waste water treatment

DATE-ISSUED: March 14, 2000

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Potter; J. Leon	Katy	TX		

US-CL-CURRENT: 210/177; 210/181, 210/195.1, 210/202, 210/257.1

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KWC
Draw Desc	Image										

☐ 2. Document ID: US 5707524 A

L14: Entry 2 of 4

File: USPT

Jan 13, 1998

US-PAT-NO: 5707524

DOCUMENT-IDENTIFIER: US 5707524 A

TITLE: Process for waste water treatment

DATE-ISSUED: January 13, 1998

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Potter; J. Leon	Katy	TX		

US-CL-CURRENT: 210/606; 210/611, 210/612, 210/631

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KWC
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☐ 3. Document ID: US 5374356 A

L14: Entry 3 of 4

File: USPT

Dec 20, 1994

US-PAT-NO: 5374356

DOCUMENT-IDENTIFIER: US 5374356 A

TITLE: Fluid treatment process using dynamic microfiltration and ultrafiltration

DATE-ISSUED: December 20, 1994

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Miller; John D.	Ithaca	NY		
Barkley; P. Glenn	Cortland	NY		
White, Jr.; Donald H.	Homer	NY		
Gingrich; Dana E.	Homer	NY		

US-CL-CURRENT: 210/641; 210/259, 210/651

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KWC
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☐ 4. Document ID: US 4412867 A

L14: Entry 4 of 4

File: USPT

Nov 1, 1983

US-PAT-NO: 4412867

DOCUMENT-IDENTIFIER: US 4412867 A

TITLE: Wet milling of starch bearing materials with water recycle after reverse osmosis or ultrafiltration

DATE-ISSUED: November 1, 1983

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Cicuttini; Amelio	Sterrebeek			BE

US-CL-CURRENT: 127/66; 127/67, 127/68, 127/69

Full	Title	Citation	Front	Review	Classification	Date	Reference	Sequences	Attachments	Claims	KWC
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L8: Entry 7 of 7

File: USPT

Apr 25, 1995

DOCUMENT-IDENTIFIER: US 5409726 A

TITLE: Method of preparing reduced fat foods

Abstract Text (1):

A method of preparing reduced fat foods is provided which employs a fragmented starch hydrolysate. A granular starch hydrolysate or a debranched amylopectin starch precipitate is fragmented to form an aqueous dispersion that is useful in replacing fat in a variety of food formulations. A wet blend of the fragmented starch hydrolysate and a hydrophilic agent is dried. The dry blend can be easily redispersed in water to form a particle gel useful in replacing fat and/or oil in a food formulation.

Brief Summary Text (4):

U.S. Pat. No. 4,510,166 (Lenchin, et al.) discloses converted starches having a DE less than 5 and certain paste and gel characteristics which are used as a fat and/or oil replacement in various foods, including ice cream and mayonnaise. The converted starches are described as dextrans, acid-converted starches (fluidity starches), enzyme-converted starches and oxidized starches. It is also disclosed that if the converted starches are not rendered cold-water soluble by the conversion, they are pregelatinized prior to use or cooked during use.

Brief Summary Text (5):

A product bulletin entitled "Paselli SA2; The Natural Alternative to Fats and Oils" (Avebe b.a., Foxhol, Holland, Ref. No. 05.12.31.167 EF) discloses the use of a low-DE-hydrolysate (DE less than 3) made from potato starch as a replacement for fifty percent of the fat with an amount of the low-DE-potato starch hydrolysate plus water (starch hydrolysate at 28% dry solids) equal to the amount of fat replaced.

Brief Summary Text (7):

The preparation of ready-to-spread frostings having reduced levels of calories is disclosed in U.S. Pat. No. 4,761,292 (Augustine, et al.). The patent discloses a frosting which contains (a) about 40 to 85 weight percent sugar, at least about 20 weight percent of which comprises fructose; (b) about 1 to 12 weight percent of a granular starch having a cold-water solubility of greater than 50 weight percent and a fat content of less than 0.25 weight percent; (c) about 5 to 30 weight percent fat; and (d) about 10 to 30 weight percent water. The patent also discloses, at column 5, lines 25-38, that the preferred frostings contain 8 to 18 weight percent fat in comparison to conventional frostings which routinely contain about 18 to 30 weight percent fat.

Brief Summary Text (9):

This invention relates to a method of preparing a dry blend of a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic agent selected from the group consisting of hydrophilic polymers, alkane polyols, surfactants, and mixtures of two or more thereof, effective to improve the redispersibility of said dry blend in a major amount of water comprising:

Brief Summary Text (11):

drying said wet blend at a temperature low enough to prevent the dissolution of a major proportion by weight of said fragmented starch hydrolysate in the water of said aqueous environment, said minor amount of hydrophilic agent being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water.

Brief Summary Text (12):

The term "hydrophilic agent" as used hereinafter, shall mean a member selected from the group consisting of hydrophilic polymers, alkane polyols, surfactants, and mixtures of two or more thereof, effective to improve the redispersibility of said dry blend in a major amount of water as discussed more fully hereinafter.

Brief Summary Text (13):

This invention also relates to a composition of matter comprising a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic agent, said minor amount of hydrophilic agent being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water.

Brief Summary Text (14):

This invention also relates to a method of forming a particle gel comprising mixing a composition of matter comprising a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic agent, said minor amount of hydrophilic polymer being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water, wherein the shear employed to form such particle gel is less than the shear needed to form a particle gel having the same gel strength as a particle of the fragmented starch hydrolysate alone.

Brief Summary Text (15):

This invention also relates to a method of formulating a food containing a fat and/or oil ingredient comprising replacing at least a substantial portion of said fat and/or oil ingredient with a composition of matter comprising a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic agent, said minor amount of hydrophilic polymer being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water.

Brief Summary Text (16):

This invention also relates to a food formulation having a reduced level of fat and/or oil comprising a mixture of a foodstuff and a blend composition as a replacement for at least a substantial portion of the fat and/or oil of said food formulation, said blend composition comprising a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic agent, said minor amount of hydrophilic agent being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water.

Brief Summary Text (20):

The fragmented, granular starch hydrolysate is made by the sequential acid-hydrolysis and fragmentation of a granular starch material, preferably derived from a starch having a major proportion of amylopectin. Starch is generally comprised of a highly-branched glucan having .alpha.-1,4 and .alpha.-1,6 linkages, denominated amylopectin, and a substantially linear glucan, having almost exclusively .alpha.-1,4 linkages, denominated amylose. Methods of determining the amounts of each are referenced in R. L. Whistler, et al., Starch: Chemistry and Technology, pp. 25-35 (Academic Press, Inc., New York, N.Y., 1984), the disclosure of which is incorporated by reference. Examples of starches having a major proportion of amylopectin include the common non-mutant starches of cereals and legumes, e.g. corn, wheat, rice, potato and tapioca, and mutant varieties comprised of a major proportion of amylopectin, e.g. waxy maize. Preferred for use herein are common corn starch and waxy maize starch.

Brief Summary Text (22):

Various pretreatments of the native granule starting material can be performed so long as the resistance to gelatinization during acid-hydrolysis is preserved. A particularly useful pretreatment is defatting of the granule, e.g., by an alkaline wash as described in U.S. Pat. No. 4,477,480 (Seidel, et al.), the disclosure of which is incorporated herein by reference, and/or a solvent extraction as described in U.S. Pat. Nos. 3,717,475 and 3,586,536 (Germino et al.), the disclosures of which are incorporated by reference. The granular starch from which the hydrolysate is made should generally contain less than about 1.5% fatty acids and proteins. Because the hydrolysis is accomplished in a predominantly aqueous medium and is typically washed with only water, the hydrolysis will not remove any substantial portion of the lipids present in the starch. Further, because a substantial portion of the starch is hydrolyzed to products soluble in the aqueous medium and subsequent wash water, the hydrolysis and washing will remove starch solids and, thus, result in a lipid content on a weight percentage

basis that is higher for the hydrolysate than the parent starch.

Brief Summary Text (27):

It has been found that the weight average molecular weight (M.sub.W) as measured by gel permeation chromatography exhibits a better correlation (better than PMW) to the yield stress of an aqueous dispersion of the fragmented starch hydrolysate. The M.sub.W should generally range from about 3,000 to about 12,000, preferably about 4,000 to about 7,500 and more preferably 4,500 to about 6,500. Of course, M.sub.W also correlates to peak molecular weight, but some factors (e.g., the efficiency of washing of the product centrifuge cake which can affect the cold-water solubles content of the product) can affect the degree of correlation between M.sub.W and peak molecular weight from lot to lot of a given production run. Molecular weights of starch hydrolysates can be measured by the procedure described by J. Bouchard, et al., "High-Performance Liquid Chromatographic Monitoring of Carbohydrate Fractions in Partially Hydrolyzed Corn Starch", J. Agric. Food Chem., Vol. 36, pp. 1188-1192 (1988), the disclosure of which is incorporated herein by reference.

Brief Summary Text (28):

The Dextrose Equivalent (by Lane-Eynon method DE) of the starch hydrolysate will vary based on the precise degree of hydrolysis and the efficiency of the washing of the starch hydrolysate, but will typically be greater than about 3, more typically greater than about 5, e.g. from about 5.0 to 7.0.

Brief Summary Text (29):

The starch hydrolysates, and fragmented dispersions thereof, can be analyzed by a variety of techniques. For example, low angle (or "small angle") X-ray scattering experiments can be performed on an aqueous dispersion of a fragmented starch hydrolysate and the results (particularly those in the Porod region of the spectrum) may show an ordering (or lack thereof) in the dispersion in the range of tens to hundreds of angstroms. Such low-angle X-ray scattering techniques are described in F. Reuther, et al., "Structure of Maltodextrin Gels--A Small Angle X-Ray Scattering Study", Colloid and Polymer Science, 261, 271-276 (1983), the disclosure of which is incorporated by reference. Further, wide angle X-ray scattering techniques (e.g. those described by S. Nara, et al., "Study on Relative Crystallinity of Moist Potato Starch", Starke/Starch, Vol. 30, pp. 111-114 (1978)) can be performed on the starting starch, the starch hydrolysate powder and on the aqueous dispersion of fragmented starch hydrolysate to examine the effects of hydrolysis and/or fragmentation on the ordering of the starch material in the range of about 1-15 angstroms, i.e., ordering related to the distances between atoms in the starch material.

Brief Summary Text (30):

Nuclear magnetic resonance techniques (e.g. those described by S. Richardson, "Molecular Mobilities of Instant Starch Gels Determined by Oxygen-17 and Carbon-13 Nuclear Magnetic Resonance", Journal of Food Science, Vol. 53, No. 4, pp. 1175-1180 (1988)) can be used to show the electronic environment of atomic nuclei in the starch hydrolysate, e.g. carbon-13, and thus give information relating to molecular structure and disposition (e.g. carbohydrate ring conformations, Vander Waals bonding, etc.). The technique of measuring water mobility (or immobility, its inverse) by oxygen-17 NMR may be supplemented with Raman infra-red spectroscopy techniques in the "water-band" of the infra-red portion of the spectrum (e.g. techniques such as those described by C. Luu, et al., "Model Structure for Liquid Water", Travaux de la Societe de Pharmacie de Montpellier, Vol. 41, No. 3, pp. 203-212 (1981), the disclosure of which is incorporated herein by reference). Differential Scanning Calorimetry (DSC) can be employed to examine the solubility of the starch hydrolysate in water (before and/or after fragmentation) over various temperatures. Such DSC techniques are described, for example, by D. C. White and G. N. Lauer, "Predicting Gelatinization Temperatures of Starch/Sweetener Systems for Cake Formulation by Differential Scanning Calorimetry. I. Development of a Model", Cereal Foods World, Vol. 35, No. 8, pp. 728-731 (August 1990), the disclosure of which is incorporated by reference.

Brief Summary Text (38):

The starch hydrolysis product of the slurry is isolated as the solid phase residue by separation thereof from the aqueous phase of the slurry. Techniques for such isolation include filtration (e.g. horizontal belt filtering), centrifugation (e.g. disk, decanter or solid bowl), sedimentation, and other suitable dewatering operations. It should also be noted that the efficiency of the separation of the insoluble starch hydrolysate residue from the aqueous liquid phase of the hydrolysate slurry and the degree of washing of the residue will affect the relative amounts of cold-water insoluble hydrolysate and cold-water soluble hydrolysate in the residue. However, it

appears that the residue is relatively resistant to washing in the sense that relatively large amounts of cold-water solubles remain after washing (by simple reslurrying and recentrifugation at ambient temperatures). Thus, while the washing of the residue will affect the amount of cold-water soluble hydrolysate, conventional washing appears to have a surprisingly small effect.

Brief Summary Text (39):

The acid in the slurry can be neutralized either before or after isolation of the hydrolysate. However, it has been found particularly advantageous (in terms of obtaining a desirably bland flavor for the hydrolysate) to (i) only partially neutralize the slurry to a weakly acidic pH (e.g. from about 2.0 to about 3.5) and (ii) then hold the slurry at a moderately elevated temperature (e.g. 25.degree. C. to 75.degree. C.) for a short period of time (e.g. 15 minutes to 24 hours), prior to isolation, followed by washing and then neutralization of the solid hydrolysate residue to a substantially neutral pH (e.g. about 4.5 to about 5.0). This acid washing of the starch hydrolysate is particularly advantageous when employed in the context of microfiltration of the starch hydrolysate slurry using a ceramic microfiltration membrane contained within an acid resistant (e.g. polyvinyl chloride) housing.

Brief Summary Text (40):

It has been found that microfiltration is an effective means of separating an insoluble starch hydrolysate residue from an aqueous slurry thereof which also contains a relatively large amount of dissolved species, e.g. salt and saccharides.

Microfiltration is described generally in D. R. Paul and C. Morel, "Membrane Technology", Encyclopedia of Chemical Technology, Vol. 15, pp. 92-131 (Kirk-Othmer, eds., John Wiley & Sons, Inc., New York, N.Y., 3d ed., 1981), the disclosure of which is incorporated herein by reference.

Brief Summary Text (41):

Typically, a liquid including small dissolved molecules is forced through a porous membrane. Large dissolved molecules, colloids and suspended solids that cannot pass through the pores are retained. Components retained by the membrane are collectively referred to as a concentrate or retentate. Components which traverse the membrane are referred to collectively as filtrate or permeate. Diafiltration is a microfiltration process in which the retentate is further purified or the permeable solids are extracted further by the addition of water to the retentate. This process is analogous to washing of a conventional filter cake. The use of microfiltration removes salts formed by the neutralization of the alkaline solution and other small molecular species.

Brief Summary Text (42):

Ultrafiltration is generally described and discussed by P. R. Klinkowski, "Ultrafiltration", Encyclopedia of Chemical Technology, Vol. 23, pp. 439-461 (Kirk-Othmer, eds., John Wiley & Sons, Inc., New York, N.Y., 3d ed., 1983), the disclosure of which is incorporated by reference herein. Ultrafiltration is a pressure-driven filtration on a molecular scale. The porous membrane typically has a pore size ranging from 0.005 to 20 micrometers (or microns). While a distinction is often made in the separation art between ultrafiltration (pore size range of 2 to 20 nanometers) and microfiltration (pore size greater than 20 nanometers), the terms will be used interchangeably herein unless expressly noted otherwise.

Brief Summary Text (45):

The isolated starch hydrolysate is typically washed and then dried (e.g. to a low moisture content, typically 3-8%) after isolation to allow for handling and storage prior to further processing. Examples of drying techniques include spray drying, flash drying, tray drying, belt drying, and sonic drying. The dried hydrolysate may be hygroscopic, given the presence of the cold-water soluble hydrolysate therein. Thus, some rehydration during handling and storage may occur. Depending upon the precise composition of the hydrolysate and the conditions (including length of time) of storage, steps to maintain the moisture at a low content may be necessary (e.g. moisture barrier packaging and/or control of humidity in the storage environment). If the moisture content is allowed to rise too far (e.g. greater than about 20%, or possibly greater than 15%), bulk handling problems and/or microbiological stability problems might arise.

Brief Summary Text (47):

In certain embodiments, this invention relates to a dry granular starch hydrolysate composition consisting essentially of a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate, said dry,

granular starch hydrolysate having (a) weight average molecular weight of from about 4,000 g/mol to about 7,500 g/mol, (b) a bland organoleptic character, and (c) an essentially dry moisture content.

Brief Summary Text (49):

In certain embodiments, this invention employs a composition of matter comprising (i) a major amount by weight of a granular starch hydrolysate, said granular starch hydrolysate having a weight average molecular weight of less than about 12,000 g/mol and being comprised of a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of a cold-water soluble hydrolysate, and (ii) a minor amount of salt selected from the group consisting of alkali metal chlorides, alkali metal sulfates, alkaline earth metal chlorides, alkaline earth metal sulfates, and mixtures of two or more thereof, said salt being present in an amount sufficient to produce an organoleptically fat-like aqueous dispersion upon fragmentation of said composition in an essentially aqueous medium at about 20% dry solids of said starch hydrolysate. Typically, said salt is present in an amount of at least 0.1% basis dry weight of said granular starch hydrolysate, preferably at least about 1%, and more preferably about 1% to about 3%.

Brief Summary Text (51):

In another aspect, this invention employs a composition of matter comprising (i) a major amount by weight of a granular starch hydrolysate, said granular starch hydrolysate having a weight average molecular weight of less than about 12,000 g/mol and being comprised of a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate, and (ii) a carbohydrate saccharide (in addition to said cold-water soluble hydrolysate) in an amount effective (e.g., a comparable amount by weight, see below) in relation to the amount of said fragmented granular starch hydrolysate and said water to enhance the fat-like properties of said dispersion following either freezing or heating to a temperature of about 72.degree. C.

Brief Summary Text (52):

In another aspect, this invention employs an aqueous dispersion useful as a replacement for fats and/or oils comprising a major amount by weight of water and a minor amount by weight of a fragmented granular starch hydrolysate, said fragmented granular starch hydrolysate being (i) comprised of a major amount by weight of cold-water insoluble hydrolysate material and a minor amount by weight of cold-water soluble hydrolysate material and (ii) capable of imparting to said dispersion at about 20% solids a yield stress of from about 100 to about 1,500 pascals.

Brief Summary Text (53):

It is believed that the cold-water soluble hydrolysate material improves the water immobilization capability of such cold-water insoluble hydrolysate material, as compared to aqueous dispersion containing only cold-water insoluble material at the same level of cold-water insoluble material solids. In general, the "minor amount" will be a significant amount in terms of its effect on the properties of the composition, e.g., the ratio of cold-water insoluble to cold-water soluble will be no greater than about 9:1, typically less than about 5:1, and preferably from about 3.0:1 to about 4.0:1.

Brief Summary Text (56):

The mechanical disintegration of the hydrolysate may be carried out in several ways, as by subjecting it to attrition in a mill, or to a high speed shearing action, or to the action of high pressures. Disintegration is generally carried out in the presence of a major amount by weight of a liquid medium, preferably water. Although tap water is the preferred liquid medium for the dispersion of fragmented starch hydrolysate, other liquids are suitable provided sufficient water is present to hydrate the fragmented starch hydrolysate and, thus, result in a dispersion having a suitable yield stress. Sugar solutions, polyols, of which glycerol is an example, alcohols, particularly ethanol, isopropanol, and the like, are good examples of suitable liquids that can be in admixture with water in the liquid medium. It may also be convenient to fragment the starch hydrolysate in a non-hydrating medium (e.g. 95% ethanol), then solvent exchange with water, and finally redisperse the fragmented starch hydrolysate to form an aqueous dispersion. Typically, however, the starch hydrolysate will be physically fragmented in potable water. Thus, this invention relates to a method of making an aqueous dispersion useful as a replacement for fats and/or oils comprising physically fragmenting a minor amount by weight of an amylopectin starch hydrolysate in the presence of a major amount by weight of a liquid consisting essentially of water, said physically fragmenting being effective to yield an aqueous dispersion having a yield stress of from about 100

pascals to about 1,500 pascals.

Brief Summary Text (61):

This detailed description will now turn to a description of the debranched starch hydrolysate. The fragmented, debranched starch precipitate is made by the sequential steps of debranching, precipitation, and fragmentation of a starch material containing amylopectin. Starch is generally comprised of a highly-branched glucan having .alpha.-1,4 and .alpha.-1,6 linkages, denominated amylopectin, and a substantially linear glucan, having almost exclusively .alpha.-1,4 linkages, denominated amylose. Methods of determining the amounts of each are referenced in R. L. Whistler, et al., Starch: Chemistry and Technology, pp. 25-35 (Academic Press, Inc., New York, N.Y., 1984), the disclosure of which is incorporated by reference. Starches having a major proportion (i.e. at least 50% by weight) of amylopectin are preferred and examples of these include the common non-mutant starches of cereals, tubers and legumes, e.g. corn, wheat, rice, potato and tapioca, pea and mutant varieties comprised of a major proportion of amylopectin, e.g. waxy maize. Common corn starch and waxy maize starch, both of which are examples of starches containing less than 40% amylose, are useful herein. However, starches containing a major amount of amylose (e.g. 50% to 75% by weight) are also useful and may be preferred depending upon the precise properties desired in the final product. Examples of such starches from high amylose corn include HI-SET.RTM. C and HYLON.TM. (each about 55% amylose by weight) and HYLON.TM. VII (about 70% amylose by weight), all available from National Starch and Chemical Corporation, Bridgewater, N.J.

Brief Summary Text (63):

If the starch chosen as a starting material is not in pre-gelatinized or instant form, the starch must be gelatinized or pasted prior to debranching. The gelatinization or pasting process disrupts, at least in substantial part, the associative bonding of the starch molecules in the starch granule. This permits the enzyme to access to the molecule to more easily and uniformly debranch the amylopectin molecules. This disruption is accomplished by heating a slurry of the starch to a sufficient temperature for a sufficient length of time depending upon the inherent resistance of the particular starch to gelatinization and the amount of moisture present in the slurry. The slurry will typically be comprised of a major amount of water (i.e. at least 50% by weight) and a minor amount of the starch starting material (i.e. less than about 50% by weight). Preferably, the starch slurry will contain at least about 5% starch, typically between about 10% to about 25% starch. The pH of the slurry will generally be substantially neutral, i.e. from about 3.5 to about 9 and more preferably from about 6 to 8, to minimize hydrolysis of the starch molecules. The time, temperature, slurry solids and pH should be optimized to gelatinize the starch, yet minimize hydrolysis of the starch.

Brief Summary Text (64):

The appropriate temperature, pressure and period of treatment needed to provide a starch paste is preferably obtained by processing aqueous starch slurries in equipment commonly known in the art as steam injection heaters or jet cookers. In such equipment, superatmospheric steam is injected and mixed with a water slurry of starch in a throat section of a jet. Upon contact with the injected steam, the starch granules are uniformly and thermally treated under turbulent conditions whereupon the starch granules are gelatinized and solubilized. Examples of steam injection heaters wherein the temperature, pressure and feed rate can be regulated to provide the desired starch pastes are disclosed in U.S. Pat. Nos. 3,197,337; 3,219,483; and 3,133,836. More uniformly solubilized starch pastes are obtained by use of the steam injection heater in combination with a holding zone such as coiled tubing or a pressurized tank constructed to minimize liquid channeling. Other pasting equipment, e.g. heat exchangers, homogenizers, cookers, rotators, sizeometer cookers, kettle cookers, etc., may be employed provided the pasting conditions can be adequately maintained.

Brief Summary Text (68):

The optimum pH and temperature of the debranching medium will also depend upon the choice of enzyme. The debranching medium may, in addition to the water used to solubilize the starch, contain buffers to ensure that the pH will be maintained at an optimum level throughout the debranching. Examples of useful buffers include acetates, citrates, and the salts of other weak acids. With the isoamylase described above, the pH is preferably maintained at about 4.0 to 5.0 and the temperature from about 40.degree. C. to about 50.degree. C. With the thermostable pullulanase described above, the pH is preferably maintained between 5 and 7 and the optimum temperature should be between 85.degree. C. and 115.degree. C.

Brief Summary Text (71):

After the desired degree of debranching is obtained, debranching enzyme in solution is deactivated, e.g. by heating to denature the enzyme. If an immobilized enzyme is employed, the contact time of the solubilized starch is adjusted so that the starch is removed from the enzyme when the desired degree of debranching is obtained. The debranching medium may be concentrated by removal of water therefrom, e.g. by evaporation, to facilitate precipitation. The debranching medium may also be treated to remove impurities therefrom. Treatment with, for example, activated carbon will remove residual proteins and lipids that may contribute to off-flavors and/or colors.

Brief Summary Text (73):

Heating (e.g. to about 70.degree. C.) of the precipitate while in contact with a liquid medium e.g. the supernatant from original precipitation and/or fresh water following isolation of the precipitate (from the supernatant) to dissolve at least a portion of the precipitate and then reprecipitation by cooling of the suspension/solution can also be employed. This reprecipitation tends to make the precipitate resistant to melting or dissolving when an aqueous dispersion of the fragmented precipitate is exposed to heat, e.g. in a pasteurization step. In general, the higher the temperature to which the precipitate in the liquid medium is heated (and thus the greater the amount of precipitate that is redissolved), the higher the temperature at which the resulting aqueous dispersion of fragmented precipitate will be stable. Repetition of the dissolving and reprecipitation also tends to improve the temperature stability of the resulting aqueous dispersion.

Brief Summary Text (78):

The mechanical disintegration of the precipitate may be carried out in several ways, as by subjecting it to attrition in a mill, or to a high speed shearing action, or to the action of high pressures. Disintegration is generally carried out in the presence of a major amount by weight of a liquid medium, preferably water. Although tap water is the preferred liquid medium for the dispersion of fragmented starch precipitate, other liquids are suitable provided sufficient water is present to hydrate the fragmented starch precipitate and, thus, result in a dispersion having the characteristics of a particle gel. Sugar solutions, polyols, of which glycerol is an example, alcohols, particularly ethanol, isopropanol, and the like, are good examples of suitable liquids that can be in admixture with water in the liquid medium. It may also be possible to fragment the starch precipitate in a non-hydrating medium (e.g. 95% ethanol), then solvent exchange with water, and finally redisperse the fragmented starch precipitate to form an aqueous dispersion. Typically, however, the starch precipitate will be physically fragmented in potable water.

Brief Summary Text (86):

The first step in preparing a dry blend comprises preparing a mixture of a minor amount of a hydrophilic agent with a major amount of a fragmented starch hydrolysate in an aqueous environment to form a wet blend thereof. To establish the aqueous nature of environment of the mixture, the wet blend will generally comprise a major proportion by weight of water and a minor proportion by weight of solids (e.g. 10-30% dry solids by weight) from the fragmented starch hydrolysate and the hydrophilic agent. While not wishing to be bound by any particular theory unless expressly indicated otherwise, it is thought that there must be sufficient water to maintain the hydration of the surface of the fragments of starch hydrolysate, to dissolve the hydrophilic agent, and to distribute the hydrophilic agent on the surface of the fragments to a degree which will prevent an association between the fragments which inhibits the redispersibility of the fragments.

Brief Summary Text (87):

The process of wet blending will typically entail fragmentation of the starch hydrolysate in water followed by addition of the hydrophilic agent to the aqueous dispersion of fragmented starch hydrolysate. However, the starch hydrolysate and hydrophilic agent can be dry blended prior to fragmentation or the hydrophilic agent can be dissolved in the water in which the starch hydrolysate will be fragmented. To reduce the energy needed to dry the wet blend, a portion of the water can be removed from the blend prior to drying, e.g. by reverse osmosis or (depending on the molecular size of the hydrophilic agent) ultrafiltration.

Brief Summary Text (88):

After wet blending, the next step comprises drying said wet blend at a temperature low enough to prevent the dissolution of a major proportion by weight of said fragmented starch hydrolysate in the water of said aqueous environment. If the fragmented starch hydrolysate is relatively more thermally stable, e.g. it contains a major amount of

amylose or is derived from a starch which did, then the selection of drying conditions to avoid such dissolution will be made simpler. In other words, the ability of the fragmented starch hydrolysate to withstand higher temperatures make a wide variety of conditions useful for drying. However, if a relatively less thermally stable fragmented starch hydrolysate is employed, it may be necessary to carefully adjust and control the drying conditions to keep the temperature of the starch hydrolysate fragments from dissolving in the water prior to its removal. Examples of drying techniques which should be useful include spray drying, flash drying, tray drying, belt drying, and sonic drying. In general, mild drying techniques such as spray drying or flash drying, wherein there is a short retention time, and sufficient air flow around the fragments to promote evaporative cooling thereof, will be most generally useful.

Brief Summary Text (90):

The hydrophilic agent can be one or more of a variety of materials that meet certain requirements. Of course, the most important requirement is that it improves the redispersibility of the fragmented starch hydrolysate, even though it is present in a minor amount. However, it must perform this function, without interfering in the formation of a particle gel. Thus, the hydrophilic agent must be non-gelling, at least at the concentration at which it is employed and under the conditions (e.g. the presence of crosslinking additives) to which the particle gel will be exposed. As discussed above, it is believed that the hydrophilic agent must be sufficiently dispersible in water, if not at least sufficiently soluble in water, to effectively disperse the agent on the surface of the fragments of the starch hydrolysate. Of course, if the blend will be used in food, the hydrophilic agent should be edible by humans.

Brief Summary Text (92):

Examples of suitable hydrophilic agents include hydrophilic polymers, including conventional polysaccharide gums, e.g. xanthan gum, locust bean gum, and guar gum, as well as synthetic gums such as water-soluble salts of carboxyalkyl cellulose (e.g. carboxymethyl cellulose), alkyl celluloses (e.g. methyl cellulose, ethyl cellulose, methyl ethyl cellulose, etc.), hydroxyalkyl celluloses (e.g. hydroxyethyl cellulose, hydroxypropyl cellulose, etc.) and mixed hydroxyalkyl alkyl celluloses (e.g. hydroxypropyl methyl cellulose) and polyoxyalkylenes (e.g. polyethoxylates such as polyethylene glycols having a molecular weight between 200 and 9,500) can also be used. Hydrophilic polymers are discussed in more detail in J. BeMiller, "Gums", Encyclopedia of Food Science and Technology, Vol. 2, pp. 1338-1343 (John Wiley & Sons, Inc., New York, N.Y., 1992) and A. Teot, "Resins, Water-Soluble", Encyclopedia of Chemical Technology, Vol. 20, pp. 207-230 (Kirk-Othmer, eds., John Wiley & Sons, Inc., New York, N.Y., 1982, 2d ed.), the disclosures of which are incorporated herein by reference.

Brief Summary Text (93):

The amount of hydrophilic polymer in the dry blend will be minor in comparison to the fragmented starch hydrolysate (e.g. 1% to 10% by weight of the total dry solids of the dry blend) and will be effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water, without destroying the particle gel character of the resulting dispersion. Because the dry blend is, in turn, a minor proportion of the weight of the useful aqueous dispersions thereof, the hydrophilic polymer will be present in the aqueous redispersion in only nominal amounts, e.g. typically less than 3% by weight of the redispersion, more typically less than 1% by weight of the redispersion, and most typically from about 0.1% to 0.8%.

Brief Summary Text (94):

The hydrophilic agent may be an alkane polyol. Such compounds have a hydrocarbon backbone to which hydroxyl groups are covalently bonded. They are typically of low molecular weight (e.g. less than about 200 g/mol) and are humectant in nature (which is believed to be a major contributor to its effectiveness herein), but must be relatively non-volatile under the drying conditions chosen for drying of the wet blend (i.e. sufficiently non-volatile to retain an effective amount of the alkane polyol in the dried blend). Like the hydrophilic polymer, it should be water dispersible if not water soluble. Examples of alkane polyols include the simple alkane polyols such as glycerol, propylene glycol, pentaerythritol, and the like, and the hydrogenated sugars such as sorbitol, mannitol, xylitol, erythritol, threitol, and the like.

Brief Summary Text (95):

The amount of alkane polyol in the dry blend will be minor in comparison to the fragmented starch hydrolysate (e.g. 5% to 35% by weight of the total dry solids of the dry blend), although the amount is typically greater than the amount of hydrophilic

polymer and, of course, will be effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water. Because the dry blend is, in turn, a minor proportion of the weight of the useful aqueous dispersions thereof, the alkane polyol will be present in the aqueous redispersion in only nominal amounts, e.g. typically less than 10% by weight of the redispersion, more typically less than 3% by weight of the redispersion, and most typically from about 0.5% to 1.5%.

Brief Summary Text (102):

In one aspect, this invention relates to a composition of matter comprising a foodstuff, a major amount of an aqueous liquid and a minor amount of a fragmented granular, amylopectin starch hydrolysate dispersed in said aqueous liquid, said hydrolysate being comprised of a major amount of cold-water insoluble hydrolysate and a minor amount of cold-water soluble hydrolysate. It is believed that the cold-water soluble hydrolysate material improves both the high-temperature stability of the cold-water insoluble hydrolysate material in the aqueous-dispersion and the water immobilization capability of such cold-water insoluble hydrolysate material, as compared to aqueous dispersion containing only cold-water insoluble material at the same level of cold-water insoluble material solids. As an amylopectin based material, the fragmented granular starch hydrolysate will exhibit a bimaximal profile of oligomers of varying degree of polymerization with (i) a maximum in proximity to a degree of polymerization of about 13, and (ii) a maximum in proximity to a degree of polymerization of about 26. (A profile of the oligomeric composition of a starch hydrolysate (the "oligomer profile") can be obtained by the method described by K. Koizumi, et al., "High-Performance Anion-Exchange Chromatography of Homogeneous D-Gluco-Oligosaccharides and -Polysaccharides (Polymerization Degree equal to or greater than 50) With Pulsed Amperometric Detection", Journal of Chromatography, 46, pp. 365-373 (1989), the disclosure of which is incorporated by reference herein.)

Brief Summary Text (104):

In general, the blend of fragmented starch hydrolysate is incorporated into the food as an aqueous dispersion, typically comprised of a major amount (i.e. greater than 50% by weight) of water or other liquid medium and a minor amount (i.e. less than 50% by weight, typically 10% to 40%) of starch hydrolysate solids. Alternatively, the blend of fragmented starch hydrolysate can be mixed with the food along with water when the other ingredients of the food are capable of withstanding exposure to free water, e.g. a salad dressing or imitation sour cream. As noted above, the terms "food" and "foodstuffs" are intended broadly, as relating to both nutritional and/or functional food ingredients. It is contemplated that one or more food ingredients may be mixed with the aqueous dispersion of fragmented, amylopectin starch hydrolysate, or even dry mixed with the starch hydrolysate prior to mechanical disintegration.

Brief Summary Text (106):

Hydrophilic colloids can include natural gum material such as xanthan gum, gum tragacanth, locust bean gum, guar gum, algin, alginates, gelatin, Irish moss, pectin, gum arabic, gum ghatti, gum karaya and plant hemicelluloses, e.g. corn hull gum. Synthetic gums such as water-soluble salts of carboxymethyl cellulose can also be used. Starches can also be added to the food. Examples of suitable starches include corn, waxy maize, wheat, rice, potato, and tapioca starches.

Detailed Description Text (5):

A totally debranched, waxy maize starch precipitate was prepared and fragmented as follows. Into a 3-liter stainless steel beaker was placed 2,000 grams of aqueous slurry containing 5% dry solids waxy corn starch. The pH was adjusted to 4.5 using 0.5N HCl and the beaker was placed in a 95.degree. C. water bath. The slurry was stirred and allowed to gelatinize and heat at 93.degree.-95.degree. C. for 20-30 minutes. The major portion of the resulting waxy starch paste (1,150 grams paste) was placed into a pressure reactor and heated to 160.degree. C. with stirring. After stirring at 160.degree. C. for 30 minutes, the waxy starch solution was cooled to 45.degree. C. and transferred to a 2-liter 3-neck round bottom flask equipped with stirrer, thermometer and a temperature controlled water bath. To the flask at 45.degree. C. and pH 4.5 was added 50 units isoamylase enzyme (Sigma Chemical Company, St. Louis, Mo.) per gram dry basis of starch. The enzyme reaction was allowed to proceed with stirring at 45.degree. C. for 48 hours. At the end of this period, the solution was heated to boiling (approximately 100.degree. C.) to inactivate enzyme then cooled and evaporated to 20% solids using a rotary evaporator.

Detailed Description Text (6):

The resulting solution was allowed to set in a refrigerator to precipitate/crystallize.

The resulting slurry was centrifuged at about 10,000 g-force RCF in a Sorvall Centrifuge (GSA rotor) for 20 minutes. The supernatant was decanted. The sediment was resuspended in water to the original 20% solids concentration volume, heated to boiling then cooled and again allowed to precipitate/crystallize on standing in a refrigerator. The resulting slurry was centrifuged as before and the sediment dried at 50.degree. C. on a stainless tray in a forced air oven. The yield of product was calculated to be 81.3% on a dry basis.

Detailed Description Text (7):

Three additional samples were prepared in a similar manner with minor variations in treatment. Portions of all four samples were combined and heated to boiling to solubilize almost all material present in the 20% solids preparation. The hot solution was filtered through Whatman No. 1 filter paper on a Buchner funnel and the clear filtrate was placed in a refrigerator overnight to precipitate/crystallize. The resulting mass was filtered using Whatman No. 1 filter paper on a Buchner funnel and the precipitated mass was washed with additional water. The resulting wet cake was dried on a stainless steel tray overnight in a forced air oven at 50.degree. C. The dried product was ground to pass through a US #60 mesh sieve and bottled.

Detailed Description Text (8):

Into a 250 ml 3-neck round bottom flask was placed 65.0 grams of the dried product above (57.5 grams dry basis) and 106.7 grams of acidic aqueous solution containing 3.87 grams of 100% HCl (approximately 1N HCl solution). The mixture was heated to 60.degree. C. in a water bath and stirred at 60.degree. C. for 24 hours. The mixture was adjusted to pH 4.5 with 4% NaOH and then centrifuged. The supernatant was discarded and the sediment resuspended in the same volume of water and centrifuged again. The wet cake was dried in a forced air oven.

Detailed Description Text (15):

A totally debranched waxy maize starch was prepared by enzymatic hydrolysis with isoamylase (Hayashibara). A 20% d.s. slurry of waxy maize starch was jet cooked at 310.degree. F. and 60 psi. A portion of the resulting liquefied starch was placed into a 3-neck round bottom flask equipped with a stirrer, thermometer and a 45.degree. C. temperature controlled water bath. The pH of the slurry was adjusted to 4.5 with 1N HCl. The isoamylase enzyme was added to the slurry at 200 units per gram dry basis of the starch. After 48 hours, the reaction slurry was heated to greater than 80.degree. C. for 20 minutes to inactivate the enzyme. The resulting solution was placed into a beaker, covered and allowed to crystallize overnight at refrigerated temperatures. The resulting material was heated to 95.degree. C. and left to recrystallize at refrigerated temperatures overnight. The recrystallized material was then spread on a stainless steel tray and dried overnight at 50.degree. C. The material was ground to a fine powder on a TROST mill and sieved through a 38 micron screen.

Detailed Description Text (18):

Lactic acid was added to the water and mixed well with a Kitchen Aide mixer. The dry ingredients were added and incorporated into the water making a slurry. The precipitate salve and the sour cream were blended into the slurry. The resulting material was hand homogenized and refrigerated.

Detailed Description Text (21):

A totally debranched waxy maize starch precipitate was prepared and treated with .alpha.-amylase, before fragmentation, as follows. Into a Groen kettle was placed 25,400 grams of deionized water and 8,400 grams waxy maize starch (11.1% moisture) with stirring. The resulting slurry was jet cooked at 310.degree. F. to give a 20% solids waxy maize starch paste.

Detailed Description Text (23):

Into a 2-liter glass beaker was placed 218 grams (200 grams dry basis) of the debranched waxy maize starch above, 16 grams of 1M phosphate buffer and 766 grams deionized water giving a 20% suspension in 20 millimolar phosphate buffer. The suspension was heated to about 100.degree. C. (boiling) to dissolve most starch then cooled to 25.degree. C. to give freshly precipitated/crystallized material.

Detailed Description Text (25):

A 20.0% solids slurry of the above product was sheared using a small Waring blender with temperature controlled water jacket (e.g. 120 V, 60.degree. C., 8 1/2 minutes). After setting 3 hours, the yield stress was measured and found to be 408 pascals. On tasting, the texture was found to be creamier with no chalkiness of a similar preparation that had not been treated with .alpha.-amylase. Based on our experience,

. this product would be useful as a fat replacer.

Detailed Description Text (27):

Into a 3-liter, 3-neck round bottom flask equipped with stirrer, thermometer and temperature regulated water bath was placed 2,200 grams of 5% solids gelatinized waxy maize starch paste, previously heated to 96.degree. C. for 30 minutes, heated to 160.degree. C. for 30 minutes, then cooled to room temperature. To the waxy maize paste at pH 6.6 was added 11,000 units (100 units/gram dry starch) of Novo Nortek Promozyme Pullulanase Enzyme. The mixture was stirred and maintained at 58.degree.-60.degree. C. for 24 hours. Samples were taken at 6 hour, 18 hour, and 24 hour reaction periods, heated to about 90.degree. C. for about 10 minutes to inactivate enzyme, then freeze dried and analyzed by gel permeation chromatography (GPC) molecular weight.

Detailed Description Text (29):

The resulting precipitated mixture was centrifuged and the supernatant discarded. The sediment was resuspended in an equal volume of water, heated to about 90.degree. C. and allowed to precipitate in a refrigerator at 4.degree. C. overnight. The precipitated mixture was centrifuged and the supernatant was discarded. The sediment was dried on stainless steel trays at 35.degree. C. overnight. The dried product was ground to pass through a US #60 mesh sieve. Gel permeation chromatography (GPC) analytical results are reported below.

Detailed Description Text (34):

Dynamic strain sweep evaluations were performed using a model VOR Bohlin Rheometer on sheared waxy maize starch products debranched to varying degrees from 57% to 100% (e.g. 57% to 100% of the products had a molecular weight of less than 20,000) and fragmented as 25% precipitate solids in water to form a creme.

Detailed Description Text (43):

It can be seen from Table 2 that the percentage of product greater than about 75.degree. C. in melting temperature reached a maximum (about 80% of the total crystalline material present) after about 6 heating/cooling cycles. This represents a high percentage of product with melting point above 75.degree. C. Thus, it is possible that this product could be heated in water to 75.degree. C. to solubilize the melted fraction while keeping the more stable (>75.degree. C.) fraction intact. The two components could then be separated (e.g. by microfiltration) to give a new heat-stable product that is essentially all stable up to about 75.degree. C.

Detailed Description Text (45):

Another batch of waxy maize starch was jet cooked and debranched in a similar manner but at about 17% solids and for 48 hours, giving a product about 70% debranched. This product was cycled in a similar manner by heating to 75.degree. C. and cooling to 25.degree. C. After the final cycle, number 8, the product was split into two portions, one of which was analyzed without washing and the other, 8(w), was washed with water before analysis. These results are presented in Table 3. Another sample of this 70% debranched product was held at 75.degree. C. without cycling for the time equal to 6 cycles; one portion was collected without washing (A) and a second portion was collected after a water wash (B).

Detailed Description Text (50):

A 2% solids slurry of 55% high amylose corn starch (HI-SET C) was prepared by mixing 452.3 grams (400 grams dry basis) of HI-SET C corn starch with deionized water to give a total volume of 20 liters. The suspension was heated in 2-liter batches up to 160.degree. C. in a pressure reactor then cooled to about 30.degree. C. to 50.degree. C. by passing the hot solution through a cooled heat exchanger tube. The pH of the solution was adjusted to approximately 4.5 and the solution was placed in two 12-liter round bottom flasks equipped with agitation, condensers, and heat controlled water baths. The temperature was adjusted to 45.degree. C. and 400 units per gram dry basis starch of isoamylase enzyme (from Hayashibara Co. and containing 865,000 units/gram) was added to each solution. The solutions were allowed to react 20 hours then the 2% solids solutions/dispersions (the debranched starch tends to precipitate with time) were heated to 160.degree. C. in the pressure reactor as before to completely dissolve the precipitated starch and make it more readily available for isoamylase enzyme attack. The solutions were cooled, the pH again checked and found to be approximately 4.5, then 400 units per grams dry basis starch of isoamylase enzyme was again added and the reaction was allowed to proceed 18 hours at 45.degree. C. for a total reaction time of 38 hours.

Detailed Description Text (52):

- To 380 grams (350 grams dry basis) of the above dried, screened material was added 1,720 grams of deionized water to give a 20% solids slurry. The slurry was heat treated by controlled heating in a temperature controlled water bath from 50.degree. C. up to 100.degree. C. at the rate of 0.05.degree. C. per minute followed by controlled cooling from 100.degree. C. down to 50.degree. C. at the rate of 0.05.degree. C. per minute. The heat treated slurry was poured onto a stainless steel tray and dried in a forced air oven at 50.degree. C. then ground to pass through a US #60 mesh sieve. This sample served as a substrate for acid hydrolysis treatments to improve the ease of creme formation on shearing.

Detailed Description Text (53):

The above starch substrate was acid hydrolyzed at 35% solids (a thick slurry) at 80.degree. C. with an HCl solution of 0.14 Normality (includes all water and acid present in the slurry). Samples of reaction slurry were withdrawn after 6 hours, 12 hours, 18 hours and 24 hours of hydrolysis at 80.degree. C., adjusted to pH 4.5, then tray dried at 50.degree. C. and ground to pass through a US #60 mesh sieve. Additional samples hydrolyzed at 6 hours and 24 hours were washed to remove most solubles. The washing procedure followed diluting the reaction slurries approximately 50:50 with water then neutralizing with 5% NaOH. The neutralized slurries were centrifuged at 8,000.times.g for 10 minutes and the supernatant discarded. Deionized water was added back to the sediment to give the same original weight of slurry and the sediment was dispersed uniformly in the water and centrifuged. This process was repeated two more times. The samples were then tray dried as outlined above. Finally, one sample hydrolyzed for 6 hours was washed as outlined above but not dried. It was saved in the wet state. All samples were then sheared using a laboratory Waring blender with a small jacketed jar at 20% solids, 120 volts, 60.degree. C. for 8 1/2 minutes. After setting for at least 3 hours, the yield stress values were measured using a Brookfield viscometer. The results are reported below:

Detailed Description Text (60):

A 2% solids slurry of 55% high amylose corn starch (HI-SET C) was prepared by mixing 452.3 grams (400 grams dry basis) of HI-SET C corn starch with deionized water to give a total volume of 20 liters. The suspension was heated in 2-liter batches up to 160.degree. C. in a pressure reactor then cooled to about 30.degree. C. to 50.degree. C. by passing the hot solution through a cooled heat exchanger tube. The pH of the solution was adjusted to approximately 4.5 and the solution was placed in two 12-liter round bottom flasks equipped with agitation, condensers, and heat controlled water baths. The temperature was adjusted to 45.degree. C. and 400 units per gram dry basis starch of isoamylase enzyme (from Hayashibara Co. and containing 865,000 units/gram) was added to each solution. The solutions were allowed to react 20 hours then the 2% solids solutions/dispersions (the debranched starch tends to precipitate with time) were heated to 160.degree. C. in the pressure reactor as before to completely dissolve the precipitated starch and make it more readily available for isoamylase enzyme attack. The solutions were cooled, the pH again checked and found to be approximately 4.5, then 400 units per gram dry basis starch of isoamylase enzyme was again added and the reaction was allowed to proceed 18 hours at 45.degree. C. for a total reaction time of 38 hours.

Detailed Description Text (62):

To 380 grams (350 grams dry basis) of the above dried, screened material was added 1,720 grams of deionized water to give a 20% solids slurry. The slurry was heat treated by controlled heating in a temperature controlled water bath from 50.degree. C. up to 100.degree. C. at the rate of 0.05.degree. C. per minute followed by controlled cooling from 100.degree. C. down to 50.degree. C. at the rate of 0.05.degree. C. per minute. The heat treated slurry was poured onto a stainless steel tray and dried in a forced air oven at 50.degree. C. then ground to pass through a US #60 mesh sieve. This sample served as a substrate for .alpha.-amylose hydrolysis treatment to improve the ease of creme formation on shearing.

Detailed Description Text (63):

The above starch substrate was enzyme hydrolyzed at 20% solids (375 grams total slurry wt.) at 25.degree. C. with 15 units/gram starch of porcine pancreatic .alpha.-amylase (Sigma Chemical Company). Samples of reaction slurry were withdrawn (125 grams each) after 8 hours, 21 hours, and 48 hours of hydrolysis and the pH adjusted to 3.5 to inactivate enzyme. The 8 hour and 21 hour samples were filtered on a Buchner funnel followed by washing with about 250 ml each with deionized water. The sample hydrolyzed 48 hours would not filter (very, very slow) and was centrifuged (7,000.times.g), the supernatant discarded, then deionized water added back to the original sample weight. After stirring to give a homogenous mixture, this slurry was centrifuged as above and

the supernatant discarded. This procedure was repeated a final time. All wet cakes or sediment (from filtration or from centrifugation) were mixed with 8 volumes of ethanol (formula 3A) to denature any remaining enzyme. They were then either filtered or centrifuged one last time. The wet cakes and sediment were dried in a 50.degree. C. forced air oven and ground to pass through a US #60 mesh sieve. The products were weighed and yields were calculated for each. Yield stress values were obtained on 20% solids cremes prepared by shearing at 120 volts, 60.degree. C. for 8 1/2 minutes with a Waring blender equipped with a small jacketed jar. The yield stress values were measured using a Brookfield viscometer after the cremes stood at least 3 hours at room temperature. The analytical results are reported below.

Detailed Description Text (71):

The debranched solution is treated with 3% w/w (weight by weight basis) of decolorizing carbon (based on starch dry substance weight) at 90.degree. C. The colorless carbon treated solution is cooled to 5.degree. C. for 16 hours to bring about crystallization. The crystallized mass is dried in a spray drier at 15% solids after dilution with water.

Detailed Description Text (76):

Add 149 gals. city water to heated and agitated tank. Turn agitator on high and add 800 lbs. as is HI-SET C. (The HI-SET C is optionally pretreated in accordance with the teachings of U.S. Pat. No. 4,477,480.) Adjust slurry solids to 35.0 to 36.5%, if necessary. Heat slurry to 70.degree. C. Add 76 lbs. of 20.degree. Baume muriatic acid. Check titer and adjust to 0.322 meq/g, if necessary. Turn agitator to low and heat to 70.degree. C.

Detailed Description Text (77):

React at 70.degree. C. for about 5.5 hrs. until a dextrose concentration of 1.00% (measured by a dextrose analyzer such as Model 2700, Yellow Springs Instrument Co.) is present in the reaction medium supernate. After 2 hrs. of reaction, check dextrose. When dextrose will be 1.00%, neutralize to 3.0 to 4.0 pH with 50% caustic solution. Heat slurry to 90.degree. C. and maintain temperature for 1 hr. Cool to 70.degree. C., transfer to microfiltration feed tank.

Detailed Description Text (78):

Concentrate slurry to about 44% solids and diafilter to 1.5% ash in microfiltration unit. Spray dry microfiltration retentate.

Detailed Description Text (82):

Add 150 gals. city water to heated and agitated tank. Turn agitator on high and add 800 lbs. as is dent corn starch. (The dent corn starch is optionally pretreated in accordance with the teachings of U.S. Pat. No. 4,477,480.) Adjust slurry solids to 35.0 to 36.5%, if necessary. Heat slurry to 60.degree. C. Add 77 lbs. of 20.degree. Baume muriatic acid. Check titer and adjust to 0.322 meq/g, if necessary. Turn agitator to low and heat to 60.degree. C.

Detailed Description Text (83):

React at 60.degree. C. to a dextrose concentration in the supernate of 1.17%. After 12 hrs. of reaction, pull a sample every 2 hrs. and measure dextrose concentration. When dextrose is expected to be 1.17%, neutralize to 3.0 to 4.0 pH with 50% caustic solution. Heat slurry to 70.degree. C. and let stir for 1 hr. Heat slurry to 80.degree. C. and let stir for 1 hr. Cool at 70.degree. C., transfer to microfiltration feed tank.

Detailed Description Text (84):

Concentrate slurry to about 44% solids and diafilter to 1.5% ash in the microfiltration unit. Spray dry microfiltration retentate.

Detailed Description Text (86):

Slurries were prepared at 15% by weight solids (i.e. 85% by weight water) by simple dilution with simple mixing of the following dry solids:

Detailed Description Text (87):

Control A: 60 parts by weight dry solids of granular starch hydrolysate (an acid-modified food starch commercially available from the A. E. Staley Manufacturing Company as STELLAR fat replacer powder) diluted to 400 parts by weight with tap water.

Detailed Description Text (88):

Blend B: 57 parts by weight of dry solids of STELLAR granular starch hydrolysate powder

and 3 parts by weight of a low viscosity carboxymethyl cellulose (available from Aqualon Company, Wilmington, Del., as CMC-7LF) diluted to 400 parts by weight with tap water.

Detailed Description Text (89):

Blend C: 57 parts by weight of dry solids of STELLAR granular starch hydrolysate powder and 3 parts by weight of a high viscosity carboxymethyl cellulose (available from Aqualon Company, Wilmington, Del., as CMC-7HF) diluted to 400 parts by weight with tap water.

Detailed Description Text (90):

Blend D: 58.8 parts by weight of dry solids of STELLAR granular starch hydrolysate powder and 1.2 parts by weight of a xanthan gum (available from Kelco Division of Merck & Co., San Diego, Calif., as Keltrol TF) diluted to 400 parts by weight with tap water.

Detailed Description Text (91):

The slurries were sheared in the Microfluidizer at 8,000 psig at an output temperature of 56.degree.-60.degree. C. The resulting cremes were diluted to 10% solids and spray dried using a Virtis laboratory spray drier (inlet temp 193.degree. C., outlet 100.degree.-105.degree. C.). The spray dried products were redispersed at room temperature at 20% solids in water using a stirring motor with a low shear agitator stirring at 1,400 rpm for 10 minutes. The resulting cremes were similar in texture to cremes prepared in a Microfluidizer except that the sample having no added hydrocolloid took longer to disperse and had a lower yield stress, as shown in the table below.

Detailed Description Text (93):

Slurries can be prepared at 15% by weight solids (i.e. 85% by weight water) by simple dilution with simple mixing of the following dry solids:

Detailed Description Text (94):

Control E: dilute 60 parts by weight dry solids of dry debranched starch hydrolysate of Examples 15, 16, 17, 18, or 19 with 400 parts by weight tap water.

Detailed Description Text (95):

Blend F: dilute 57 parts by weight of dry solids of dry debranched starch hydrolysate of Examples 15, 16, 17, 18, or 19 and 3 parts by weight of a low viscosity carboxymethyl cellulose (available from Aqualon Company, Wilmington, Del., as CMC-7LF) with 400 parts by weight with tap water.

Detailed Description Text (96):

Blend G: dilute 57 parts by weight of dry solids of dry debranched starch hydrolysate of Examples 15, 16, 17, 18, or 19 and 3 parts by weight of a high viscosity carboxymethyl cellulose (available from Aqualon Company, Wilmington, Del., as CMC-7HF) with 400 parts by weight with tap water.

Detailed Description Text (97):

Blend H: 58.8 parts by weight of dry solids of dry debranched starch hydrolysate of Examples 15, 16, 17, 18, or 19 and 1.2 parts by weight of a xanthan gum (available from Kelco Division of Merck & Co., San Diego, Calif., as Keltrol TF) diluted to 400 parts by weight with tap water.

Detailed Description Text (98):

The slurries are sheared in the Microfluidizer at 8,000 psig at an output temperature of 56.degree.-60.degree. C. The resulting cremes are diluted to 10% solids and spray dried using a Virtis laboratory spray drier (inlet temp 193.degree. C., outlet 100.degree.-105.degree. C.). The spray dried products are redispersed at room temperature at 20% solids in water using a stirring motor with a low shear agitator stirring at 1,400 rpm for 10 minutes.

Detailed Description Text (100):

A second series of samples were prepared substantially as described in Example 21. The level of additive is expressed on a dry solids basis (i.e. wt. % of total dry solids which excludes the water added and the residual moisture in the starch hydrolysate).

Detailed Description Text (107):

STELLAR fat replacer powder was mixed with water to give four slurries containing 20% dry solids STELLAR. Glycerol was added to three of the slurries in an amount of 10%, 20% and 30% of the weight of dry STELLAR in the slurry while no glycerol was added to

one of the slurries. All the slurries were heated to approximately 50.degree. C. then sheared using the Microfluidizer at 8,000 psi using module #1351. The exit temperature was approximately 60.degree. C. The resulting creme products were spread on stainless steel trays and dried at 35.degree. C. in a forced air oven for 2 days. The dried products were ground to pass through a US #60 mesh sieve then bottled and labeled. To test the ability of the products to rehydrate at minimum shear, water was added to give slurries containing 20% STELLAR dry solids and the slurries were redispersed at room temperature using a Servodyne mixer at 1,500 rpm. Yield stress measurements were obtained on the redispersed products and are reported below.

Detailed Description Text (110):

STELLAR fat replacer neutralized reaction slurry was diluted with water and glycerol to give four slurries containing 10% dry solids STELLAR. Glycerol was added to three of the slurries in an amount of 5% (Blend CC), 10% (Blend DD) and 20% (Blend EE) of the weight of dry STELLAR in the slurry while no glycerol was added to one of the slurries (Control BB) (with a weight for weight reduction in the amount of water, i.e. glycerol replacing water). The slurries were heated to approximately 60.degree. C. then sheared using the Microfluidizer at 4,500 psi. The resulting cremes were diluted to 15% dry solids and then spray dried using the Niro spray dryer described in PCT Publication No. WO 91/12728, discussed above.

Detailed Description Text (111):

Five separate samples of each of the resulting dry products were then redispersed in water at 20% dry solids, one sample by shearing with Microfluidizer at 60.degree. C. and 8,000 psi using Module #1531, two samples with a Servodyne mixer at 1,500 rpm (one sample with water at ambient temperature and one at 60.degree. C.) and two samples with a rotary Oakes mixer, 0.061" rotor at 1,000 rpm (one sample with water at ambient temperature and one at 60.degree. C.). A 20% dry solids slurry of dry granular starch hydrolysate from Run 6F as described in PCT Publication No. WO 91/12728, discussed above, was also prepared without the addition of glycerol (Control FF). The results for each are shown in the Servodyne and Oakes columns, respectively, in the following table with the comparative comments being made with reference to the sample in the table above the subject sample.

Detailed Description Paragraph Table (1):

										Ingredients: %	
										Precipitate (30% d.s. creme)	
29.83	Water	23.41	Non-fat dry milk	5.97	Lactic acid 88%	0.40	Xanthan gum	0.20	Salt	0.20	
										Sodium citrate 0.20	

Detailed Description Paragraph Table (3):

TABLE 1

EXAMPLE 6 7 8 9 10 11 12 13

										% Conversion							
93	96	82	85	100	57	57	69	Debranching enzyme	P	P	I	I	I	P	P	P	(P -- pullulanase) (I -- isoamylase)
										% Cold <u>water</u> solubles							
31.7	37.7	21.4	30.6	24.7	34.4	99.2	29.6	powder Yield stress	118	17	498.5	1110	428	Too	Too	Too	
										pascals gelled							
25.5	--	--	--	--	13.8	11.5	creme (gel)	DSC: Onset	.degree.C.	54	47	45	--	57	--	43	
										Enthalpy							
13.8	21.3	23.6	--	20.6	--	9.5	29.3	<u>Water</u> immobilization	119	115	697	--	--	209	353	(sec.sup.-1 by .sup.17 O NMR)	
										Ratio of 1,4:1,6							
--	31/1	31/1	120/1	linkages (by NMR)	Concentration of	20	5	20	20	5	20	20	20	20	20	starch	
										(during hydrolysis) Units of enzyme							
62.5	100	200	>200	100	3.79	3.79	7.5	(per g starch)	Number of	2	2	2	2	2	1	0	
										precipitations							
Centrifugation	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	

*No

.alpha.-1,6 linkages detected

Other Reference Publication (24):

Larsson et al., "Annealing of starch at an intermediate water content", Starch/Starke, vol. 43, No. 6, pp. 227-231 (Jun. 1991).

Other Reference Publication (52):

S. Nara, et al., "Study on Relative Crystallinity of Moist Potato Starch", Starke/Starch, vol. 30, pp. 111-114 (1978).

Other Reference Publication (54):

C. Luu, et al., "Model Structure for Liquid Water", Travaux de la Societe de Pharmacie de Montpellier, vol. 41, No. 3, pp. 203-212 (1981).

Other Reference Publication (64):

A. Teot, "Resins, Water-Soluble", Encyclopedia of Chemical Technology, vol. 20, pp. 207-230 (Kirk-Othmer, eds., John Wiley & Sons, Inc., New York, N.Y., 1982, 2d ed.).

CLAIMS:

1. A method of preparing a dry blend of a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic agent selected from the group consisting of hydrophilic polymers and alkane polyols, surfactants, and mixtures of two or more thereof, effective to improve the redispersibility of said dry blend in a major amount of water comprising:

mixing a minor amount of a hydrophilic agent with a major amount of a fragmented starch hydrolysate in an aqueous environment to form a wet blend thereof, wherein at least about 95% of the fragmented starch hydrolysate has a particle size of less than 45 microns, and wherein the fragmented starch hydrolysate comprises a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate,

drying said wet blend at a temperature low enough to prevent the dissolution of a major proportion by weight of said fragmented starch hydrolysate in the water of said aqueous environment, said minor amount of hydrophilic agent being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water.

2. A method of claim 1 wherein said wet blend is comprised of a major proportion by weight of water and a minor proportion by weight of solids from said fragmented starch hydrolysate and said hydrophilic polymer.

3. A method of claim 1 wherein said wet blend is comprised of a major proportion by weight of water and 10% to 30% by weight of solids from said fragmented starch hydrolysate and said hydrophilic polymer.

4. A method of claim 1 wherein said wet blend is comprised of sufficient water to maintain the hydration of the surface of said fragments of starch hydrolysate, to dissolve said hydrophilic polymer, and to distribute said hydrophilic polymer on the surface of the fragments to a degree which will prevent an association between said fragments which inhibits the redispersibility of the fragments.

5. A method of claim 1 wherein said wet blending comprises fragmentation of said starch hydrolysate in water followed by addition of said hydrophilic polymer to the aqueous dispersion of fragmented starch hydrolysate.

6. A method of claim 1 wherein a portion of the water of said wet blend is removed from said blend prior to drying by reverse osmosis or ultrafiltration of said wet blend.

10. A method of claim 1 wherein said hydrophilic agent is edible for humans and is sufficiently soluble in water to effectively disperse the polymer on the surface of the fragments of the starch hydrolysate.

15. A method of claim 1 further comprising redispersing the dry blend in water and wherein said hydrophilic polymer is present in the dry blend in an amount insufficient to destroy the particle gel character of the resulting redispersion.

17. A method of claim 1 wherein starch hydrolysate is a granular starch hydrolysate composition consisting essentially of a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate, said dry, granular starch hydrolysate having weight average molecular weight of from about 4,000 g/mol to about 7,500 g/mol.

18. A method of claim 1 wherein said starch hydrolysate consists essentially of (i) a major amount by weight of a granular starch hydrolysate, said granular starch hydrolysate having a weight average molecular weight of less than about 12,000 g/mol and being comprised of a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of a cold-water soluble hydrolysate, and (ii) a minor amount of salt selected from the group consisting of alkali metal chlorides, alkali metal sulfates, alkaline earth metal chlorides, alkaline earth metal sulfates, and mixtures of two or more thereof, said salt being present in an amount sufficient to produce an organoleptically fat-like aqueous dispersion upon fragmentation of said composition in an essentially aqueous medium at about 20% dry solids of said starch hydrolysate.

22. A method of claim 1 further comprising redispersing the dry blend in water and wherein the resulting redispersion exhibits a transition in dynamic elastic modulus versus shear strain from substantially constant dynamic elastic modulus to decreasing dynamic elastic modulus, said transition being exhibited at a shear strain of less than about 50 millistrain.

28. A composition of matter comprising a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic polymer, said minor amount of hydrophilic polymer being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water, wherein at least about 95% of the fragmented starch hydrolysate has a particle size of less than 45 microns, and wherein the fragmented starch hydrolysate comprises a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate.

29. A method of forming a particle gel comprising mixing a composition of matter comprising a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic polymer, wherein at least about 95% of the fragmented starch hydrolysate has a particle size of less than 45 microns, and wherein the fragmented starch hydrolysate comprises a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate, said minor amount of hydrophilic polymer being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water, wherein the shear employed to form such particle gel is less than the shear needed to form a particle gel having the same gel strength as a particle of the fragmented starch hydrolysate alone.

30. A method of formulating a food containing a fat and/or oil ingredient comprising replacing at least a substantial portion of said fat and/or oil ingredient with a composition of matter comprising a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic polymer, wherein at least about 95% of the fragmented starch hydrolysate has a particle size of less than 45 microns, and wherein the fragmented starch hydrolysate comprises a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate, said minor amount of hydrophilic polymer being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water.

31. A food formulation having a reduced level of fat and/or oil comprising a mixture of a foodstuff and a blend composition as a replacement for at least a substantial portion of the fat and/or oil of said food formulation, said blend composition comprising a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic polymer, wherein at least about 95% of the fragmented starch hydrolysate has a particle size of less than 45 microns, and wherein the fragmented starch hydrolysate comprises a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate, said minor amount of hydrophilic polymer being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water.

32. A method of making a composition of matter useful in replacing fat and/or oil in a food formulation comprising:

gelatinizing a starch having an amylopectin component;

debranching the amylopectin in said gelatinized starch in a debranching medium to convert more than about 80% by weight of the amylopectin to short chain amylose and form a debranched amylopectin starch in said medium, wherein the debranched amylopectin starch comprises a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate;

fragmenting by mechanical disintegration a minor amount of said dried debranched amylopectin starch in a major amount of an aqueous liquid, wherein at least about 95% of the fragmented debranched amylopectin starch has a particle size of less than 45 microns, said fragmenting being effective to form a particle gel of said composition;

mixing a minor amount of a hydrophilic polymer with a major amount of a fragmented starch hydrolysate in an aqueous environment to form a wet blend thereof;

drying said wet blend at a temperature low enough to prevent the dissolution of a major proportion by weight of said fragmented starch hydrolysate in the water of said aqueous environment, said minor amount of hydrophilic polymer being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water.

33. A method of preparing a dry blend of a major amount of a fragmented starch hydrolysate capable of forming a particle gel in aqueous dispersion and a minor amount of a hydrophilic agent selected from the group consisting of hydrophilic polymers and alkane polyols, surfactants, and mixtures of two or more thereof, effective to improve the redispersibility of said dry blend in a major amount of water comprising:

mixing a minor amount of a hydrophilic agent with a major amount of a starch hydrolysate, wherein the starch hydrolysate comprises a major amount by weight of cold-water insoluble hydrolysate and a minor amount by weight of cold-water soluble hydrolysate,

fragmenting the mixture by mechanical disintegration in an aqueous environment to form a wet blend which comprises a major amount of a fragmented starch hydrolysate and a minor amount of a hydrophilic agent, wherein at least about 95% of the fragmented starch hydrolysate has a particle size of less than 45 microns, and

drying said wet blend at a temperature low enough to prevent the dissolution of a major proportion by weight of said fragmented starch hydrolysate in the water of said aqueous environment, said minor amount of hydrophilic agent being effective to improve the redispersibility of said fragmented starch hydrolysate when a minor amount of said blend is dispersed in a major amount of water.

WEST

Generate Collection

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L14: Entry 1 of 4

File: USPT

Mar 14, 2000

DOCUMENT-IDENTIFIER: US 6036854 A

TITLE: System for waste water treatment

Brief Summary Text (2):

The present invention relates to an improved process and system for high strength organic waste water treatment. Specifically, the invention relates to a novel process and system for processing the high strength waste water streams issuing from a variety of primary facilities including food processing plants (e.g. potato, rice, grain processing), brewery plants, dairy processing, pharmaceutical plants, or the like in order to insure that the effluent discharge into municipal sewage systems and water ways is environmentally safe and free from harmful biological contaminants. The novel process and system of the present invention provides the additional function of producing a valuable single cell protein product having direct commercial use as animal feed and as a protein and flavoring supplement in human foodstuffs.

Brief Summary Text (10):

U.S. Pat. No. 4,617,123 to Christ offers an alternative treatment solution for a waste stream. Christ presents a process for treating the waste waters issuing from the manufacture of sauerkraut. Christ subjects the entire stream of waste water to a biological process utilizing an inoculum consisting of *Candida crusei* and *Candida utilis*. After the biological treatment, Christ treats the stream to a reverse osmosis in order to form a purified liquid effluent having a purity higher than 99%. Christ makes no provisions for controlling the yeast fermentation process including identifying pH levels and necessary control additives. The Christ process is further disadvantageous because it requires subjecting the entire waste stream to the biological process--a cost prohibitive feature in larger food processing plants. Although Christ discloses a preferred yeast type in the processing of sauerkraut waste, he makes no provisions for yeast selection in other classes of waste streams.

Detailed Description Text (2):

Referring now to the drawings and particularly to FIGS. 1, there is shown a preferred embodiment of the process and system 10 for waste water treatment in accordance with the present invention. As shown, a waste stream 12 is issued from a primary processing facility (not shown), through appropriate piping, such as a food processing plant, brewery, dairy processing plant, pharmaceutical plant, or the like. Typical food processing plants well suited to operate in conjunction with the present invention are potato, rice, grain, and dairy processing plants and the like processing with an issuing waste stream heavy in organic compounds (e.g. starches and complex sugars). The specific rate of discharge will depend on the nature of the primary processing facility, but is typically in the order of at least 100,000 to 300,000 gallons per day.

Detailed Description Text (4):

The waste stream 12 is next directed to a holding tank 14 having a capacity commensurate with the flow rates of the stream 12. In operation, the specific BOD level of the waste stream 12 must be considered in order to properly implement the subject invention. In this regard, the BOD level can be maintained at a predictable and relatively consistent level by first directing the stream through a filtration unit 16 in order to concentrate the waste stream 12. Preferably, filtration unit 16 is one that performs ultrafiltration of the waste stream 12. Ultrafiltration is a process for separating dissolved materials (e.g. starches, sugars, etc.) as measured by their molecular size and shape. The ultra filter 16 is generally a fine filter comprising a selectively permeable membrane which retains macromolecules above a specified size while allowing the smaller molecules and solvent to pass through as a filtrate or permeate. Ultra filters 16 are available in a number of commercial configurations

including spiral wound, hollow fiber and flat leaf systems. In the preferred embodiment, an ultra filter that retains molecules from 1,000 to 10,000 molecular weight is provided in order to insure the diversion of all the useful carbon constituents. In this way, the high BOD starches and sugars are retained while the environmentally clean filtrate 18 is directed to a municipal sewage system or returned to the primary facility for use therein as clean water. For example, a waste water stream 12 having 1.5% solids and 5,000 ppm BOD prior to ultrafiltration will have 18% solids and 30,000 ppm BOD after ultrafiltration.

Detailed Description Text (42):

Direct 21 gal/min. stream through 10,000 molecular weight membrane.